

Full Length Research Paper

# Effects of sodium azide on yield parameters of groundnut (*Arachis hypogaea* L.)

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The mutagenic effects of different concentrations of sodium azide (0.01 – 0.05%) on groundnut (*Arachis hypogaea* L. cv SS1145B and RMP 91) were investigated. The characters studied include; plant height, number of branches per plant, pods/plant, seeds/pod, seeds/plant and 100 seed weight in the M<sub>1</sub> and M<sub>2</sub> generations. Both negative and positive shifts in mean values were recorded as a result of the chemical treatment. The most effective dosage for inducing mutation/morphological aberration was established at 0.03%. Increases in genetic parameters of variation, heritability and genetic gain under the chemical treatment indicate the possibility of evolving higher yield variants through proper crop selection. Thus, economic traits like pods/plant, seeds/plant with high heritability and genetic gain values in the M<sub>3</sub> generation offer good scope for selection and improvement.

**Key words:** Groundnut, mutagenic effects, phenotypic variance, sodium azide.

## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an important oil seed crop and grain legume worldwide. However, it is self-pollinating and possesses limited variability. Consequently, the extent to which groundnut cultivars may be improved through conventional breeding methods is limited. Mutation breeding supplement conventional plant breeding as a source of increasing variability and could confer specific improvement without significantly altering its acceptable phenotype (Ojomo et al., 1979). The successful utilization of sodium azide to generate genetic variability in plant breeding has been reported in barley (Kleinhofs and Sander 1975) and other crops (Avila and Murty, 1983; Micke, 1988; Routaray, et al., 1995).

It has been demonstrated by many workers that genetic variability for several desired characters can be induced successfully through mutations and its practical value in plant improvement programmes has been well established. The main advantage of mutation breeding is the possibility of improving one or two characters without changing the rest of the genotype. The varieties of groundnut in West Africa have remained relatively unimproved and little work has been carried out on them. The present study was undertaken to investigate the mutagenic effects of sodium azide as a means of increasing the

variability within the cultivars and hence improve its productivity.

## MATERIALS AND METHODS

Seeds of groundnut (cv SS1145B and RMP 91) were selected from a batch obtained from the Nigeria Seed Company, Zaria, Nigeria. The seeds were treated with 0.01, 0.02, 0.3, 0.04, 0.05% (weight /volume) solutions of sodium azide (NaN<sub>3</sub>) at room temperature (25°C) with intermittent shaking. A set of 100 seeds was kept in distilled water to serve as control. After 24 h of treatment, all seeds were washed in distilled water to remove toxic products, if any, and sown directly on field plots following a randomized block design and maintaining a spacing of 25 x 50 cm. The parameters studied included: germination/emergence percentage, seedling survival at 21 days after planting (DAP), plant height at 21 DAP, number of days to maturity, branches/plant, pods/plant, seeds/pod, seeds/plant and 100 seed weight. The mutagenic effectiveness and efficiency were calculated following the methods of Sisikala and Kamala (1988).

At maturity, M<sub>1</sub> plants were individually harvested and sown as M<sub>2</sub> family. During the M<sub>3</sub>, five of the characters were evaluated further using the following genetic parameters: (a) genetic variance, (b) phenotypic variance, (c) heritability and genetic gain in accordance with Allard (1999). The selection pressure was 10% for the purpose of this investigation.

## RESULTS AND DISCUSSION

The effect of the different concentrations of sodium azide on survival percentages, mutation frequency and mutagenic effectiveness is presented in Table 1. The survival percentages decreased progressively as the dosage incr-

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**Table 1.** Effect of sodium azide on mutagenic effectiveness, efficiency and survival of groundnuts during the M<sub>1</sub> generation.

Variety/conc. (%)	Survival percentage	Percentage lethality (L)	Mutagenic frequency (M)	Mutagenic effectiveness M/C	Mutagenic efficiency M/L
<b>SS1145B</b>					
0.01	65	35	2.07	2.07	0.06
0.02	50	50	14.05	7.03	0.28
0.03	45	55	27.15	9.05	0.49
0.04	35	65	23.50	5.88	0.36
0.05	25	75	10.40	2.08	0.14
<b>RMP91</b>					
0.01	87.5	12.5	3.70	3.70	0.30
0.02	43.8	56.2	14.0	7.00	0.25
0.03	25.0	75.0	42.4	14.13	0.57
0.04	12.0	88.0	19.7	4.93	0.22
0.05	6.5	93.5	8.5	1.70	0.09

**Table 2.** Effect of sodium azide on some yield parameters of groundnut in M<sub>1</sub> and M<sub>2</sub> generations.

Variety / conc. (%)	Plant Height (cm)		Number of days to maturity		Number of primary branches/plant		Number of pods/plant		Number of seeds/pod		Number of seeds/plant	
	M <sub>1</sub>	M <sub>2</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>1</sub>	M <sub>2</sub>	M <sub>1</sub>	M <sub>2</sub>
<b>SS1145B</b>												
0.00	13.07±1.0	13.90±1.3	56.0±2.4	54.1±2.7	1.7±0.8	1.7±0.9	38.3±2.8	37.2±2.6	5.13±1.4	6.1±1.5	22.5±2.8	21.9±2.9
0.01	12.80±0.78	13.4±0.90	40.0±4.1	48.3±5.6	1.8±0.9	1.8±1.1	42.5±4.9	41.4±3.8	5.80±2.5	6.9±3.1	23.6±3.8	23.0±6.0
0.02	9.40±0.90	12.70±1.68	50.0±3.8	52.4±5.7	1.8±0.9	1.8±1.2	42.6±5.6	43.9±6.3	6.00±2.4	6.8±4.2	23.7±4.4	24.4±5.5
0.03	10.80±1.53	12.0±1.70	56.0±3.3	54.8±6.3	1.9±0.9	1.9±1.3	55.3±6.6	60.0±7.1	7.17±2.6	7.4±4.8	29.1±3.7	31.6±6.2
0.04	12.3±1.15	13.4±2.30	56.0±3.7	56.4±5.8	1.9±0.9	1.9±0.8	51.3±6.1	57.4±8.9	6.60±2.8	6.8±4.9	27.1±3.7	30.2±6.4
0.05	8.25±1.72	12.8±3.70	58.0±2.9	57.2±6.1	1.9±0.7	1.9±0.9	29.3±8.3	41.94±9.4	5.00±2.7	6.7±4.6	16.3±5.2	23.3±23.3
<b>RMP91</b>												
0.00	10.0±1.00	11.4±1.15	56.4±2.6	56.8±2.4	1.8±0.4	1.8±0.3	36.4±2.3	37.1±2.2	6.1±1.6	6.6±1.5	2.820.2±	20.6±2.6
0.01	9.6±1.80	10.9±2.40	50.0±4.5	52.1±6.1	1.6±0.6	1.6±0.8	31.2±5.7	37.3±6.8	11.80±2.5	10.4±3.3	19.3.95±	20.7±5.8
0.02	9.6±1.88	10.3±3.10	55.0±4.1	54.3±5.8	1.5±0.8	1.5±0.9	27.45±6.7	36.4±7.1	8.43±2.4	9.1±3.6	18.3±5.1	20.2±6.4
0.03	5.76±2.12	8.4±2.45	58.0±3.8	54.3±5.3	1.7±0.8	1.7±0.9	24.5±5.5	37.8±6.8	5.33±2.7	5.8±2.9	14.4±5.5	21.0±5.3
0.04	8.03±2.92	10.57±3.53	56.5±4.4	55.5±7.1	1.7±0.7	1.7±0.9	20.9±3.9	50.8±8.9	11.80±2.9	10.4±3.0	12.3±6.1	24.2±11.9
0.05	4.00±3.1	9.52±4.1	45.8±4.3	50.5±5.8	1.5±0.8	1.5±1.0	17.1±4.3	32.4±9.2	5.42±3.1	4.8±3.1	11.4±7.1	18.0±10.2

**Table 3.** Estimate of parameters of variability, heritability and genetic gain of five yield characters of two groundnut cultivars grown from seeds treated with sodium azide and untreated seeds (control) in the M<sub>3</sub> generation.

Cultivar	Characters	Treatment	Range	Mean	PV	GV	H <sub>o</sub>	GA	GG
SS1145B	Primary branches	Control	5.13 – 6.10	5.80	2.26	1.41	62.49	0.15	2.59
		Treated	5.0 – 7.4	6.45	2.38	1.63	68.49	0.269	4.45
	Pods/plant	Control	21.9 – 22.50	22.10	7.45	6.10	81.86	1.13	5.50
		Treated	16.3 – 31.60	26.50	8.55	7.90	92.45	4.04	15.25
	Seeds/pod	Control	1.70 – 1.80	1.76	1.58	1.19	75.32	0.47	2.67
		Treated	1.60 – 19.0	1.83	1.45	1.12	77.24	0.500	2.73
	100 sd wt	Control	40.07 – 40.98	40.25	2.64	1.82	68.94	2.34	5.81
		Treated	40.00 – 41.00	40.32	2.60	1.82	70.38	3.33	8.26
	No. of seeds/plant	Control	37.23 – 40.9	38.90	14.11	10.75	76.18	0.99	2.54
		Treated	29.34 – 60.04	48.50	18.01	15.1	83.84	3.63	7.48
RMP91	Primary branches	Control	6.10 – 6.8	6.51	2.16	1.40	74.80	.173	2.66
		Treated	4.80 – 10.4	7.33	2.26	1.55	68.60	.321	4.38
	Pods/plant	Control	14.14 – 14.42	14.28	7.95	6.30	79.25	.80	5.60
		Treated	12.6 – 19.94	15.75	8.74	7.90	90.4	2.53	16.06
	Seeds/pod	Control	1.75 – 1.82	1.75	1.19	0.98	70.90	0.4	2.74
		Treated	1.81 – 2.11	1.90	1.31	1.06	77.20	0.54	2.84
	100 sd wt	Control	36.06 – 36.88	36.23	2.70	1.80	66.70	2.11	5.82
		Treated	36.0 – 36.90	36.29	2.74	1.85	67.50	3.00	8.27
	No. of seeds/plant	Control	24.04 – 25.96	25.00	14.11	10.75	76.19	0.99	3.96
		Treated	22.68 – 32.19	29.93	18.01	15.10	83.84	3.63	12.12

PV = Phenotypic variance  
 GV = Genetic variance  
 H<sub>o</sub> = Heritability  
 GA = Genetic advance  
 GG = Genetic gain

eased. Mensah and Akomeah (1992) have reported that the higher the mutagenic dose, the lower the survival percentage, and the present results confirm these earlier reports. The decrease in survival percentage has been attributed to the physiological disturbance or chromosomal damage caused to the cells of the plant by the mutagen. Adegoke (1984) reported that sodium azide induces chromosomal damages leading to bridge formation during mitotic division and hence increased phenotypic aberration Table 2.

The mutagenic frequency recorded in the present investigations ranged from 2.07 to 54.0% and the frequency increased with increasing dosage of the chemical. The morphological aberrations used in the determination of the mutation frequency included distorted leaf forms and swollen and/or shortened internodes. The spectrum of chlorophyll mutants also considered in assessing the mutation frequency includes xantha (completely yellow), chlorina (variegated yellow and green) and albina (whitish). Out of these, xantha type was predominant in both cultivars.

The genetic parameters of variation, heritability and genetic gain for five selected yield parameters are given in Table 3. The genetic variance (GV) ranged from 0.90 to 15.1. Similarly, the phenotypic variance (PV) ranged from 1.91 to 18.01. The phenotypic variance was higher than the genetic variance. However, the differences between the two measurements were low for pods/plant and seed/plants, inferring low environmental influence on these traits. The differences were higher for primary branches and 100 seed wt. The heritability expresses the reliability of the phenotypic value as a guide to breeding. Characters with high heritability can therefore be improved rapidly through selection than those with low heritability, since the latter are influenced by environmental factors. In the present study, the heritability values recorded were greater than 50% in all traits studied. These values are considered high and varied from 62.49 to 92.45%. The predicted genetic gain at 10% selection varied from 2.59 to 16.06%. These values were generally higher in the treated plants than the control. This observation is similar to what was reported in *V. unguiculata* by Mensah and Erutator (1993) and Mensah et al. (2005).

High heritability, coupled with high expected gains were observed for number of pods/plant and number of seeds / plant indicating that additive gene effects played an important role in the expression of such traits. Thus, these traits could be effective in the selection of high yielding cultivars/genotypes. The characters in which heritability has already been reported among legumes include plant height, pods/plant, 100 seed weight and seed yield (Gregory, 1955; Williams and Hanway, 1961).

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